separately, by following the outline with the tracing point of the planimeter.

Whichever of the methods of graphical measurement is adopted, the total length of the division lines divided by ten and multiplied by the scale of the indicator spring will give the mean effective pressure for each stroke. The average of the two mean pressures must be taken, and the indicated horse-power can be computed as follows:

Let A equal area of cylinder in square inches, P the average mean pressure in pounds per square inch for both strokes, L the length of stroke in feet,

N the revolutions per minate, then $\text{I.H.P.} = \frac{aPLAN}{33{,}000}$.

CHAPTER I

Stationary Engines

Introduction.—Stationary engines are used mainly for the generating of power for industrial purposes, and several examples of large units will be described and illustrated, but more attention will be given to the latest development known generally as the Uniflow type, which has achieved such signal success that several firms who have long been identified conspicuously with the manufacture of what were the prevailing types, have almost entirely abandoned them in order exclusively to take up that of the Uniflow type.

Fig. 6 shows the usual arrangement of cylinder, &c. The working barrel is a separate casting furnished with deep cellular covers in which the admission valves are placed. The steam inlets are in the covers, which are thus jacketed by high-pressure steam. The valves and seats are fixed in the covers quite close to the internal surface, so that the ports are short and the clearance volume is small. There is a ring of exhaust ports at the centre of the length of the barrel, which communicate with the exhaust belt. The collective area of these ports may be made large, and if desirable the condenser, when of the jet type, may be placed immediately below the

cylinder exhaust branch, so that the difference in pressure between the condenser and the cylinder at exhaust could be very small.

With a surface condenser it is usual to interpose an oil separator, in order to prevent the tubes becoming coated with a film of oil, and thereby prevent oil getting into the boilers when the condensate is used for boiler feed. Sometimes a feed heater is placed immediately below the exhaust branch. The axial length of the exhaust ports is usually about 10 per cent of the stroke, so that the piston, which itself forms the exhaust valve, has a length of 90 per cent of the stroke. Compression takes place, of course, during 90 per cent also of the stroke.